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1992 Feature Article - Leading Indicators of the Australian Business Cycle: Performance over the Last Two Decades

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Introduction

This article is the second in a series dealing with the Australian business cycle and its leading indicators. The first described the Australian business cycle (Salou and Kim 1992). The objective of this article is to verify and assess the temporal relationships at turning points between the Australian business cycle and a selection of main economic indicators. These temporal relationships are often taken for granted. This article provides an overview of the fluctuations in some main economic indicators over the past two decades. The study also tries to identify the lengths of the leads and lags involved. Only the bivariate relationships between the Australian business cycle and a selection of main economic indicators are examined here. It is not intended to provide any explanation of the causes of the business cycle, but rather to observe the temporal relationships around turning points in the business cycle between aggregate economic activity and a selection of individual statistics. The methodology is presented and then the results are shown, ordered by lead time. General comments on the results conclude the article.

Selection of main economic indicators

Economic relevance was the main criterion for the selection of main economic indicators. Individual economic indicators can be classified in the four following categories according to the reasons for their temporal relationship with an aggregate measure of economic activity (de Leuw 1989):

- Causes of the fluctuations in general economic activity: for instance instruments of economic policy like interest rates;
- Expectation related indicators: for instance share prices;
- Measures of economic activity at an early stage of the production process: for instance building approvals, leading indicators of activity in the construction sector;
- Indicators which adjust quickly to changes in economic activity: for instance overtime worked.

It should be noted that an individual indicator can fall into more than one category.

Other important criteria in the selection of indicators were the length of the time series available and the extent of their dissemination. Most series selected are published in Australian Economic Indicators (cat. no. 1350.0). Some of them, real interest rates or real money stock for instance, had to be constructed. The methods of construction have been kept as simple as possible and

have been mainly limited to ratios or subtractions. Details of these methods are presented in the section on results. Of course, due to limited resources, the selection for analysis also involved an element of subjective judgement. From the significant results only those showing the strongest relationships with the business cycle have been reported.

Identification of short-term fluctuations

Time series can be broken down into seasonal and trading-day variations, irregular short-term movements, long-term trend and, finally, the business cycle components. The objective here is to provide insights into the business cycle, that is into short-term economic fluctuations which correspond to cycles between two and eight years of total duration. Cycles shorter than two years are more likely to be associated with irregular movements such as measurement errors and socio-economic shocks. Fluctuations corresponding to long-term trends (defined in this study as cycles of durations longer than eight years) originate from changes in structural factors such as technology, culture or demography. Estimates of the different components are obtained by using filters, in this case Henderson moving averages. The series containing only the short-term economic fluctuations is obtained by removing the long-term trend element from the series already corrected for seasonal, trading days and irregular movements. This method of cyclical analysis is known as the "growth cycles" approach and is used by most of the institutions working on business cycle determination (OECD 1987). It has been applied to the average of the three measures of Gross domestic product, GDP(A), to provide the timing of the turning points in the Australian business cycle (Salou and Kim 1992). The same method was applied here to extract the short-term fluctuations from the selected main economic indicators and the charts below show the results of the process.

Lead-lag analysis methodology

A visual examination of the short-term fluctuations of each series was first conducted to identify the turning points in each series using the same method as for the determination of the turning points in the Australian business cycle. The cycles of each series were compared to the reference business cycles. As can be seen from the charts below, a perfect matching of the cyclical fluctuations between the individual indicators and the business cycles, namely with a regular lead or lag and all cycles present, is very difficult to achieve and indeed was not found in any of the series examined. All economic cycles are different in their duration, amplitude, causes and effects. This explains why the business cycles do not appear regularly in each of the selected economic indicators. In this study, an indicator series was said to have demonstrated "cyclical conformity" with the reference series when it showed one and only one cycle per cycle in the reference series. This allowed the determination of different dates for the respective turning points. Departure of one phase was accepted in both directions, allowing the possibility of having one extra or missing cycle in an indicator series covering the reference period.

When an indicator series demonstrated cyclical conformity, two simple statistics were computed on the observed leads or lags:

- The means of the leads or lags were calculated separately at all turning points, at all peaks and at all troughs. Unfortunately, given the small number of turning points observed, it was not possible to assess the significance of these statistics.
- Cross-correlations, i.e. correlations between the reference series and the zero to seven quarter lead and lag of each indicator were computed. The lead or lag corresponding to the maximum value of these fifteen correlation coefficients gives another estimate of the length of the lead or lag involved. This measure gives an indication of the temporal relationship between the series not only at turning points but over the whole period of observation. Results reported here are all statistically significant within a confidence interval of 95%.

Results

Table 1 lists the turning points of each individual series as well as its relative position compared to the reference cycle. The relative positions are indicated in quarters below each turning point's date. Positive numbers indicate a lead, negative numbers a lag and zeros coincidence. "na" means that no data were available and blank spaces mean that no turning points were identified in the period. Series are ordered by descending lead time.

TABLE 1. TURNING POINTS IN INDIVIDUAL INDICATORS (YEAR.QUARTER)

Numbers below turning point represent the relative position of the indicator series to the business cycle expressed in quarters														
GDP(A)	Trough 72.2	Peak 73.4	Trough 75.3	Peak 76.3	Trough 77.4	Peak 78.4	Trough 80.2	Peak 82.1	Trough 83.1	Peak 85.3	Trough 86.4	Peak 89.4	Trough 91.3	
Duration(quarters)	6	7	4	5	4	6	7	4	10	5	12	7		
Real interest rate (a)	70.2	71.4	74.2	75.1	77.1			80.3	82.1	83.1	85.3	87.4	89.3	
Housing finance	8	8	5	6	3			6	4	10	5	8	8	
Business prospects	71.3	72.3	74.3					81.1	82.3	83.4	86.2	88.3	90.1	
All industrials	71.4	73.1	74.4	76.1	77.1	78.3	79.3	81.2	82.4	83.4	85.4	89.4	90.4	
Commodity prices	72.2	74.1	75.2	76.2			78.4	80.4	82.2	85.1	86.3	88.3	91.1	
Real M1	72.2	74.1	75.4			78.2	80.1	82.1	83.1	85.1	87.1	88.4	90.2	
Building approvals	na	73.4	74.4	76.3	78.2			81.3	82.4	85.2	87.1	89.1	90.4	
United States GDP	71.4	73.2	75.1	76.1	77.4	78.4	80.3	81.2	82.4	84.2	87.1	90.2	91.2	
Terms of trade	72.1	73.3	75.1	76.3	78.1	79.3			82.3	84.4	87.1	89.1	91.2	
Job vacancies	na	na	na	na	na	na	na	81.4	83.2	85.2	87.4	89.2	91.2	
New registrations	72.1	73.3	75.4	76.2	78.1	79.3	80.1	82.3	83.1	85.3	87.1	90.2	91.1	
CPI	73.1	74.4	76.2	77.1	79.1	80.1	81.1	83.3	84.4	87.1	89.1	90.4		
(a) Inverted	-3	-4	-3	-2	-5	-5	-3	-6	-7	-6	-9	-4		

Table 2 gives the different statistical measures of the temporal relationships between each individual series and the reference series. Missing or extra cycles are also indicated in Table 2. The twelve charts presented at the end of this article show the short-term fluctuations in each of the selected indicators together with the Australian business cycle. The vertical lines on each graph indicate the dates of the successive turning points in the Australian business cycle.

TABLE 2. MEANS OF LEADS/LAGS AND CROSS CORRELATIONS OF SELECTED ECONOMIC VARIABLES

Maximum cross-correlation	Mean lead/lag at turning points	Cycles

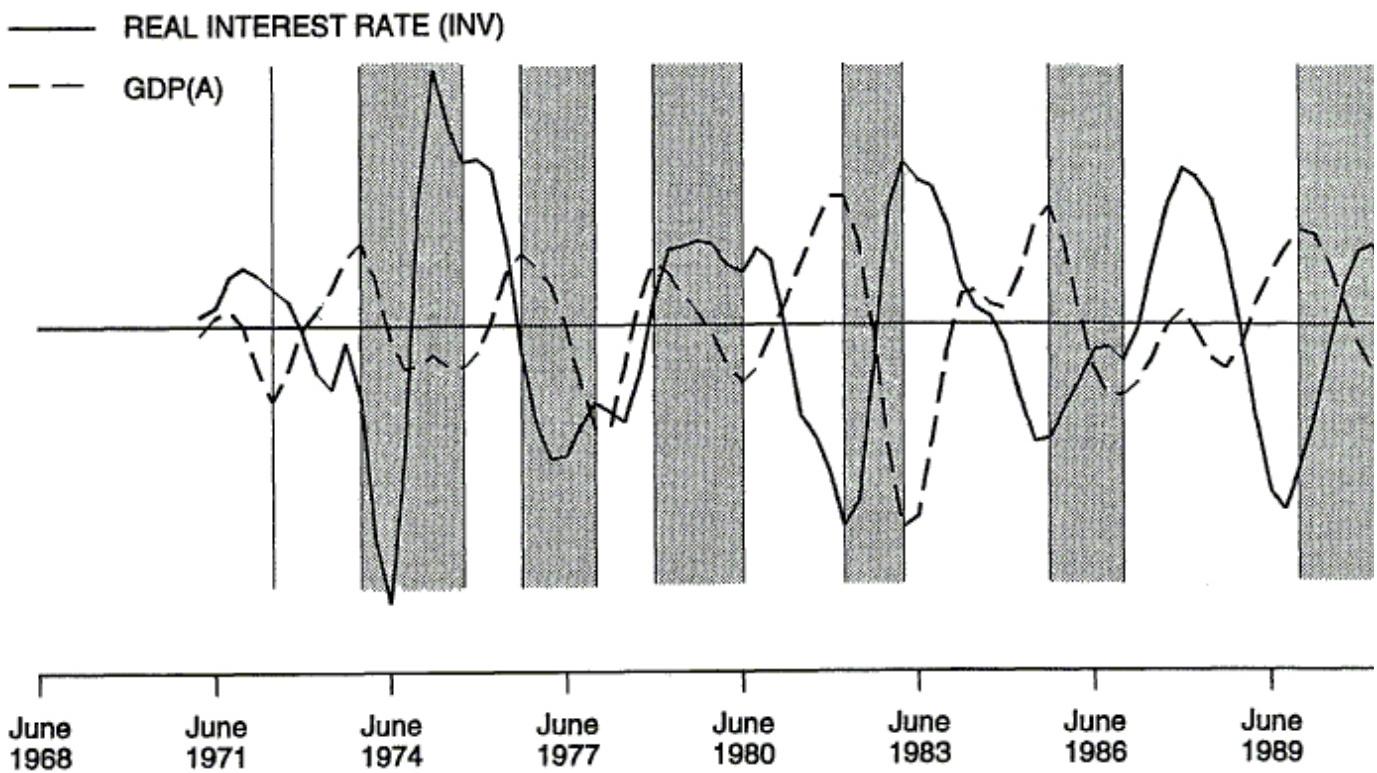
	Lead (quarters)	Correlation	Observations	All (quarters)	Peaks (quarters)	Troughs (quarters)	Extra (year.quarter)	Missing (year.quarter)
Real interest rate (a)	6	0.50	85	6.5	7.6	5.5		78.4-80.2
Housing finance	4	0.53	66	2.4	3.7	1.5		78.4-80.2
Business prospects	3	0.50	85	3.8	5.3	2.6		76.3-80.2
All industrials	2	0.54	85	2.8	2.7	2.9	87.3-88.1	
Commodity prices	2	0.29	85	2.3	2.4	2.2		77.4-78.4
Real M1	1	0.39	85	1.0	1.4	0.7		76.3-77.4
Building approvals	1	0.65	79	1.0	1.2	0.8		78.4-80.2
United States GDP	1	0.66	85	1.1	1.7	0.6		
Terms of trade	1	0.48	85	0.7	0.8	0.7		80.2-82.1
Job vacancies	1	0.88	49	0.0	1.3	-1.3		
New registrations	0	0.48	85	-0.3	-0.8	0.1	74.1-75.1	
CPI (a) Inverted	-5	0.51	85	-4.7	-4.5	-5.0		

The following paragraphs describe the results for each of the selected variables. First, the theoretical reasons for the selection of the series are given and the data is described. Then the results are discussed and particular attention is given to missing or extra cycles as well as to the occurrence of "false signals", which are multiple turns in the indicator series not corresponding to cyclical turning points in the reference series. Finally, results obtained for similar indicators which have not been included in the tables and charts are mentioned.

Interest rates

Interest rates are clearly in the category of driving forces of the economy even though the transmission mechanism of their impact on real activity is complex and widely debated. An estimate of real short-term interest rates was computed by subtracting the annual growth in the private consumption deflator (growth rate from the corresponding quarter the year before) from the quarterly average of the 90 day bank bill interest rate. This estimate demonstrated relatively good cyclical conformity, particularly over the three cycles of the 1980s. Visual examination and cross-correlation coefficients revealed evidence of coincident pro-cyclical behaviour in the original series and anti-cyclical behaviour with a lead of seven quarters when the inverted series was used. However, with these methods it was not possible to determine which predominated. The results of Granger causality tests supported the former, which is consistent with Keynesian economic theory and with previous work on the subject (Lowe 1992). The series missed the 1977Q4 - 1978Q4 phase but showed a limited number of false signals. Similar results were obtained using the yield spread between the 90 day bills rate and the rate for 10 year government bonds.

CHART 1. REAL INTEREST RATES (INVERTED) AND GDP(A), DEVIATION FROM TREND



Construction sector indicators

Housing finance commitments and building approvals are typical of early indicators of changes in economic activity. These statistics are obtained at an early stage of the production process in the construction sector. They may also incorporate expectations from the banking sector and from households. The series for the value of total secured housing finance commitments to individuals (cat. no. 5609.0) deflated by the consumer price index (housing), was found to lead the business cycle by an average of three quarters. The series for the value of total private building approvals (cat. no. 8731.0) deflated by the consumer price index (housing), was found to lead the business cycle by one quarter on average. Both series miss the 1977Q4 - 1978Q4 phase. While the series for housing finance showed many false signals, the series for building approvals did not show any.

CHART 2. SECURED HOUSING FINANCE: TOTAL COMMITMENTS TO INDIVIDUALS AND GDP(A), DEVIATION FROM TREND

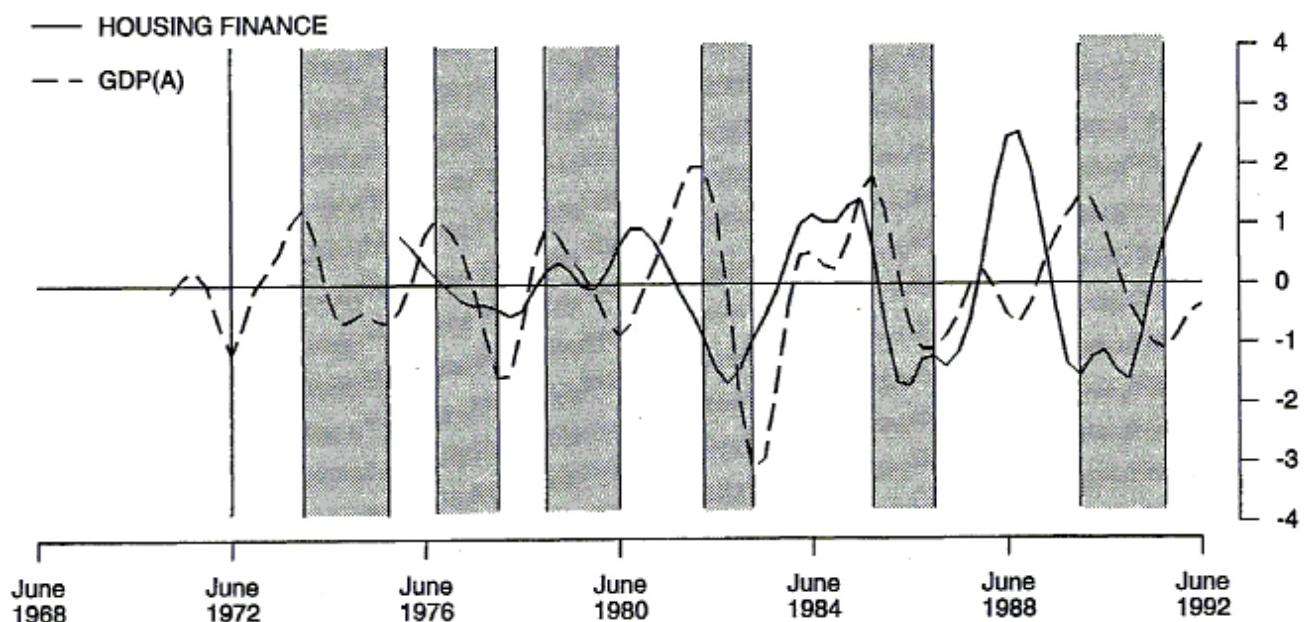
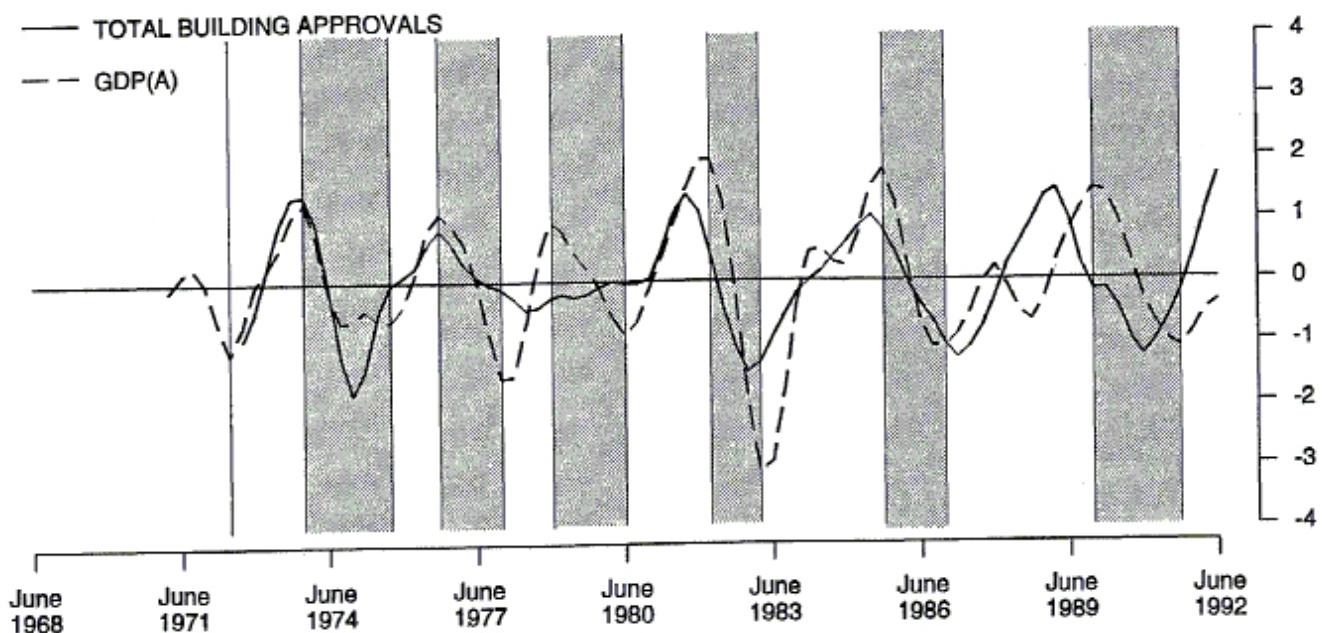


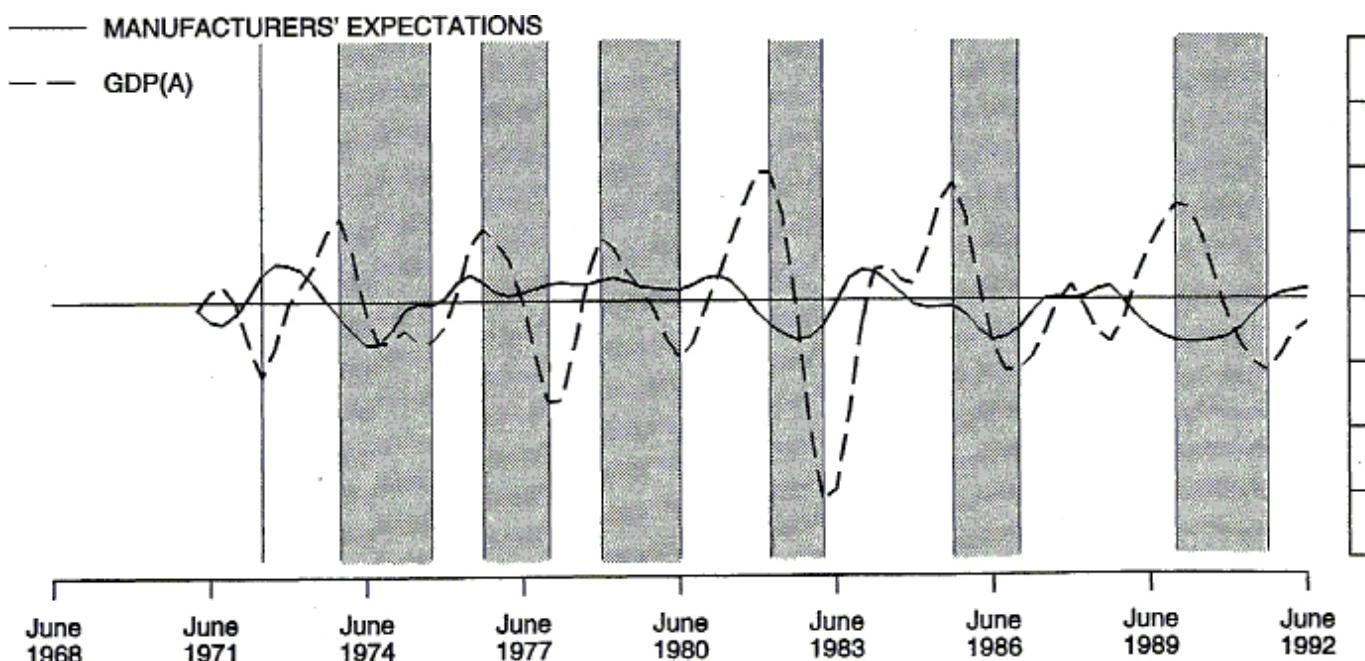
CHART 3. TOTAL BUILDING APPROVALS AND GDP(A), DEVIATION FROM TREND



Surveys of expectations

Data on expectations are designed to be used to monitor the fluctuations in economic activity. Expectations of a sample of large Australian manufacturers have been used here. These statistics are compiled by the Australian Chamber of Commerce and Industry and Westpac. This series, expressed as a diffusion index, has been smoothed but not detrended since it is not appropriate to look for a long-term trend in entrepreneurs' expectations. As can be seen on Chart 4 the series showed a strong cyclical pattern but missed the two cycles of the late 1970s. It was nevertheless accepted that the series demonstrated cyclical conformity. The series was found to lead the business cycle by three to four quarters. The number of false signals was very limited. Similar results have been found with data on expectations of future production and of new orders.

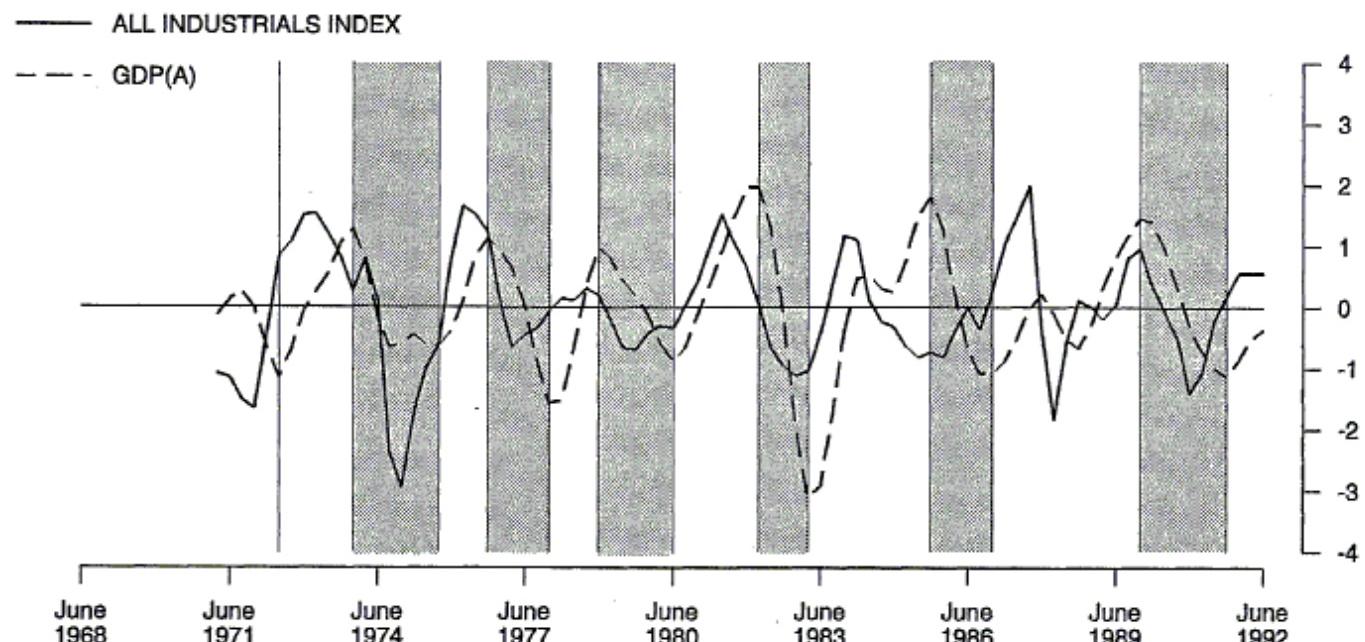
CHART 4. MANUFACTURERS' EXPECTATIONS AND GDP(A), DEVIATION FROM TREND



Share prices

Share prices reflect expectations of the future course of economic activity. Two series of share prices have been tested, the "All ordinarys" and the "All industrials" indexes. The first is an index of the market prices of over 240 Australian companies on the Sydney and Melbourne Stock exchanges and includes mining, oil, industrial and financial companies. The second excludes mining, oil and other resources. Both series were found to lead the business cycle by an average of three quarters for all turning points and for peaks and troughs separately. For both, the maximum cross-correlation was obtained at lead two. Short-term fluctuations in the "All Industrials" index are shown in the graphs and the tables. An extra phase appears with a peak in 1987Q3 and a trough in 1988Q1. This extra cycle reflects the October 1987 stock market crash and appeared in all the stock market related series tested.

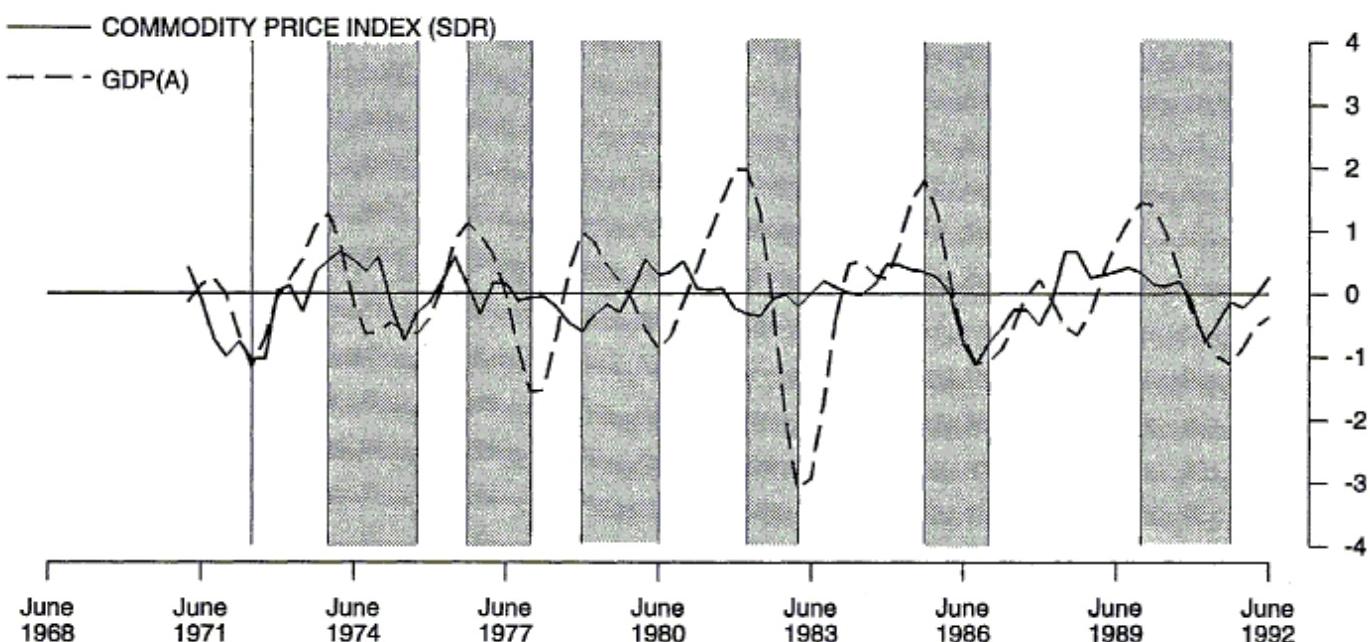
CHART 5. ALL INDUSTRIALS INDEX AND GDP(A), DEVIATION FROM TREND



Commodity prices

Fluctuations in commodity prices reflect fluctuations in the demand for commodities and hence for Australian exports. The commodity price index used was that compiled by the Australian Bureau of Agricultural and Resource Economics (ABARE). It includes the more relevant world market prices for Australian export commodities weighted by their share of exports in 1987-1988. It is expressed in Special Drawing Rights (SDR) to exclude exchange rate movements. This series was found to be leading the business cycle by two quarters on average. The commodity prices series does not indicate the 1978Q4 - 1980Q2 phase and shows many false signals as shown on the graph. Commodity prices expressed in Australian dollars or in US dollars did not show an acceptable cyclical conformity with the business cycle.

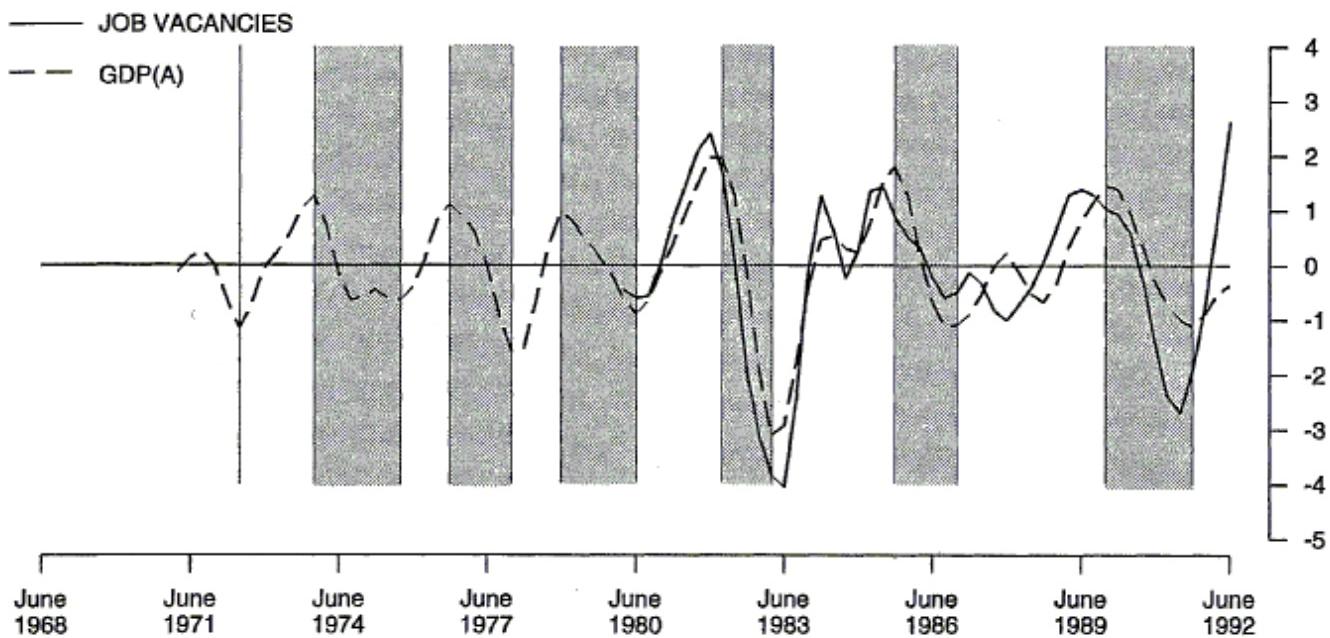
CHART 6. COMMODITY PRICE INDEX (SDR) AND GDP(A), DEVIATION FROM TREND



Job vacancies

Movements in the job vacancies data reflect both pressures on production capacity and expectations of future activity. ABS quarterly data on job vacancies, all industries (cat. no. 6354.0), are available in continuous series from 1980. Chart 7 shows the cyclical conformity of this series over the last three cycles. The series was found to lead the business cycle by zero to one quarter but more observations are required in order to reach a solid conclusion. Results shown in Tables 1 and 2 show that job vacancies adjusted quicker at peaks than at troughs. This implies that employers stop hiring quicker than they start hiring. The double-turns in activity observed in 1984-1985 and in 1987-1989 were reflected in the job vacancies series. The correlation coefficient was the highest observed for the selected indicators but the period of observation was shorter. The unemployment rate did not show an acceptable cyclical conformity.

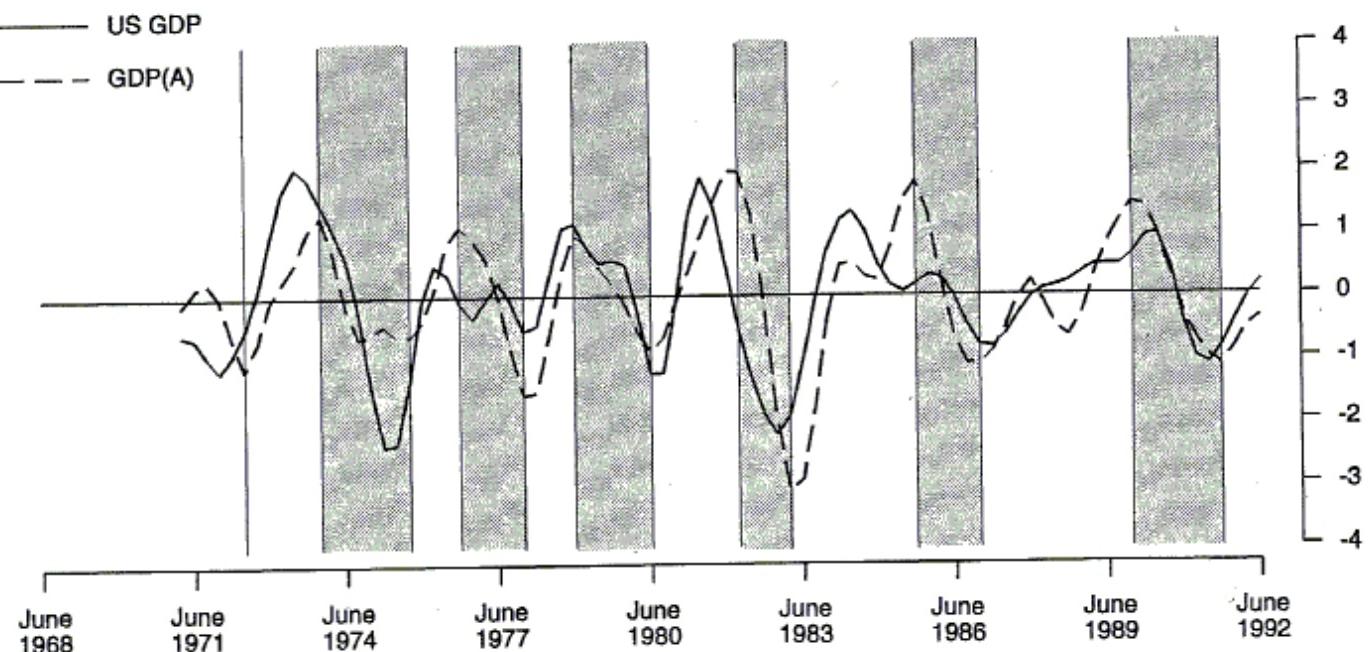
CHART 7. JOB VACANCIES (ALL INDUSTRIES) AND GDP(A), DEVIATION FROM TREND



External activity: United States Gross domestic product

The United States Gross domestic product (United States Bureau of Economic Analysis, Department of Commerce) is an indicator of cyclical movements of both world-wide activity and part of the external demand for Australian products, since the United States is the largest economy in the world and an important trading partner for Australia. US GDP had a cyclical pattern very similar to that of GDP(A), with no missing or extra cycles, as can be seen on chart 8. The mean lead was 1.1 with the lead at peaks being 1.7 and at troughs 0.6. Other data tested included the Japanese GNP, Japanese imports and the OECD composite leading indicators of industrial production for these two countries. These indicators did not perform as well as US GDP in terms of cyclical conformity and lead time.

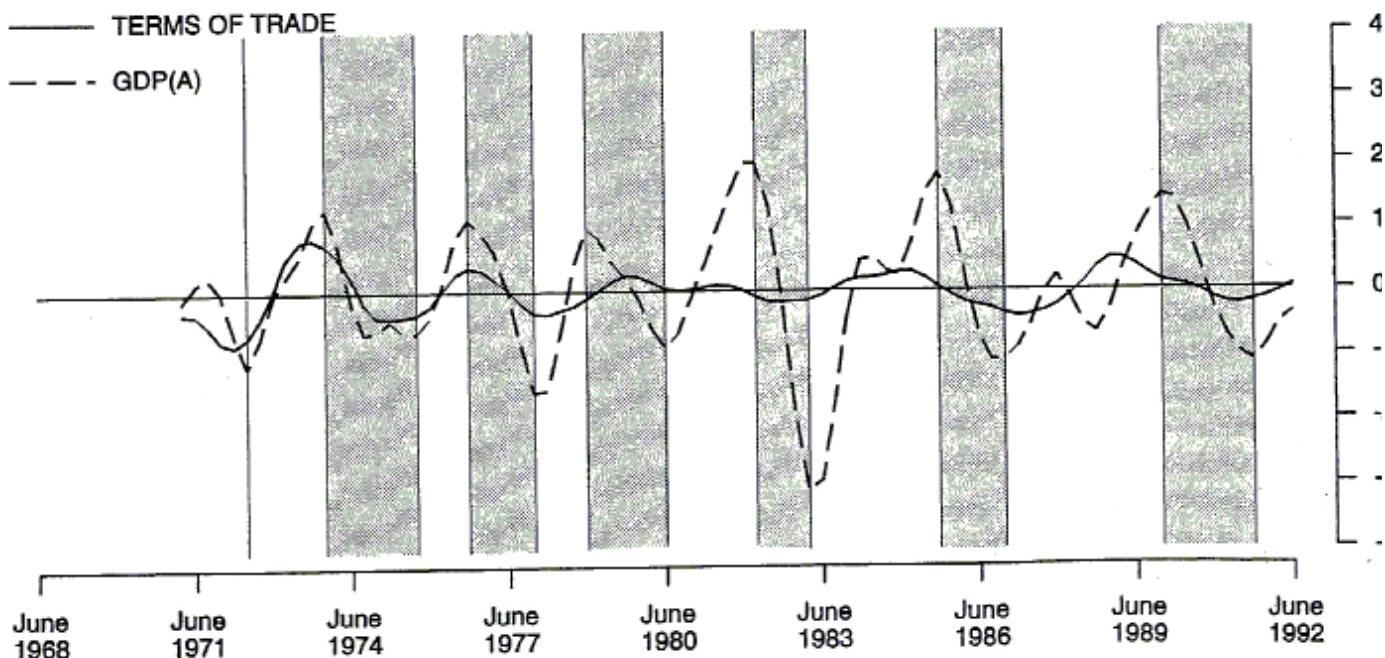
CHART 8. US GDP AND AUSTRALIAN GDP(A), DEVIATION FROM TREND



Terms of trade

The terms of trade reflect the competitiveness of the Australian economy. The terms of trade index, available from the Australian national accounts (cat. no. 5206.0), was found to be leading the business cycle at peaks and to be coincident at troughs, on average. The series misses the 1978Q4 - 1980Q2 - 1982Q1 cycle. It appears in this series as a double-turn. The maximum cross-correlation was obtained at lead one.

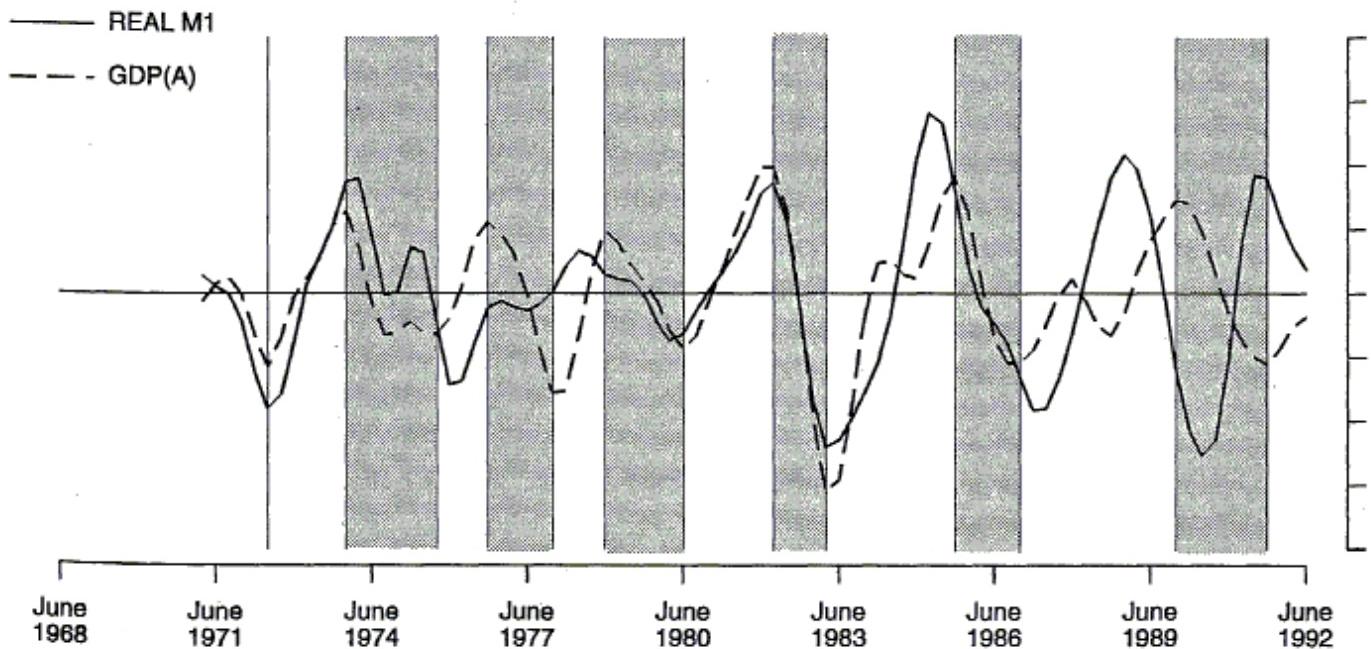
CHART 9. TERMS OF TRADE AND GDP(A), DEVIATION FROM TREND



Monetary aggregates

The reasons why monetary aggregates are related to the business cycle have been studied in depth by economists and many theories have been used to analyse this relationship. The results of two series, M1 and M3, are reported here but only M1 is shown on the tables and on the graphs. M1 measures the public's holdings of currency plus the current deposits of trading banks. M3 adds to M1 all deposits with banks. M3 was the monetary target between 1976 and 1984. Unless deflated, the two series do not show any temporal relationship with the business cycle using our methodology. The two series have been deflated using the private consumption deflator from the national accounts and the deflated data are referred to hereafter as real M1 and real M3. The analysis indicated that real M1 leads the business cycle by one quarter. The series did not present false signals but missed the 1976Q3 - 1977Q4 phase. The relationship also seemed to have changed at the end of the 1980s when the lead increased to more than one year. Real M3 showed a cyclical pattern close to that of the reference series and was found to be coincident with a maximum cross-correlation obtained at lead zero. The series showed a tendency to lead at peaks. The October 1987 stock exchange crash was very evident in this series, while the trough of 1986 in the reference series is reflected as a double-turn here. Some broader monetary aggregates have been included in the tests and all of them showed a lagged temporal relationship with the business cycle. More details on the links between financial indicators and aggregate economic activity can be found in M.Bullock et al 1988.

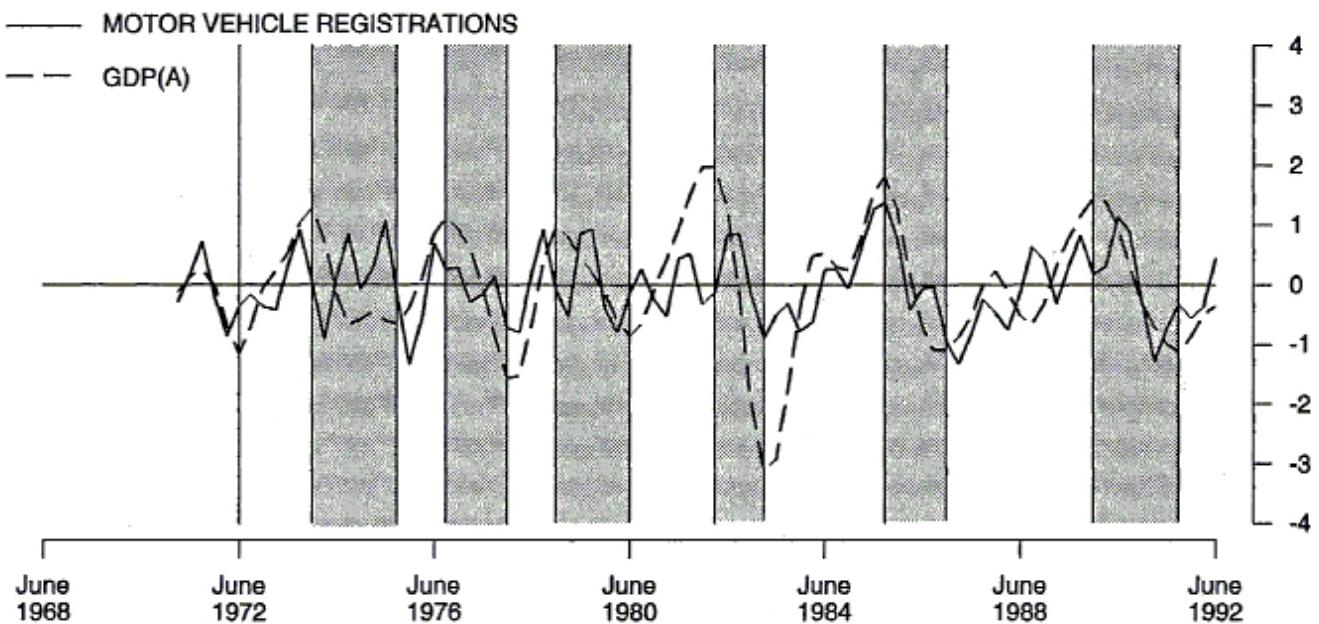
CHART 10. REAL M1 AND GDP(A), DEVIATION FROM TREND



New motor vehicle registrations

New motor vehicle registrations, cars and station-wagons (cat. no. 9303.0), which is an early indicator of fluctuations in consumption, was found to be coincident with the business cycle. This was consistent with the definition of the series. It exhibited a lot of false signals and an extra cycle in the 1973Q4 - 1974Q3 contraction.

CHART 11. MOTOR VEHICLE REGISTRATIONS (CARS AND STATION WAGONS) AND GDP(A), DEVIATION FROM TREND

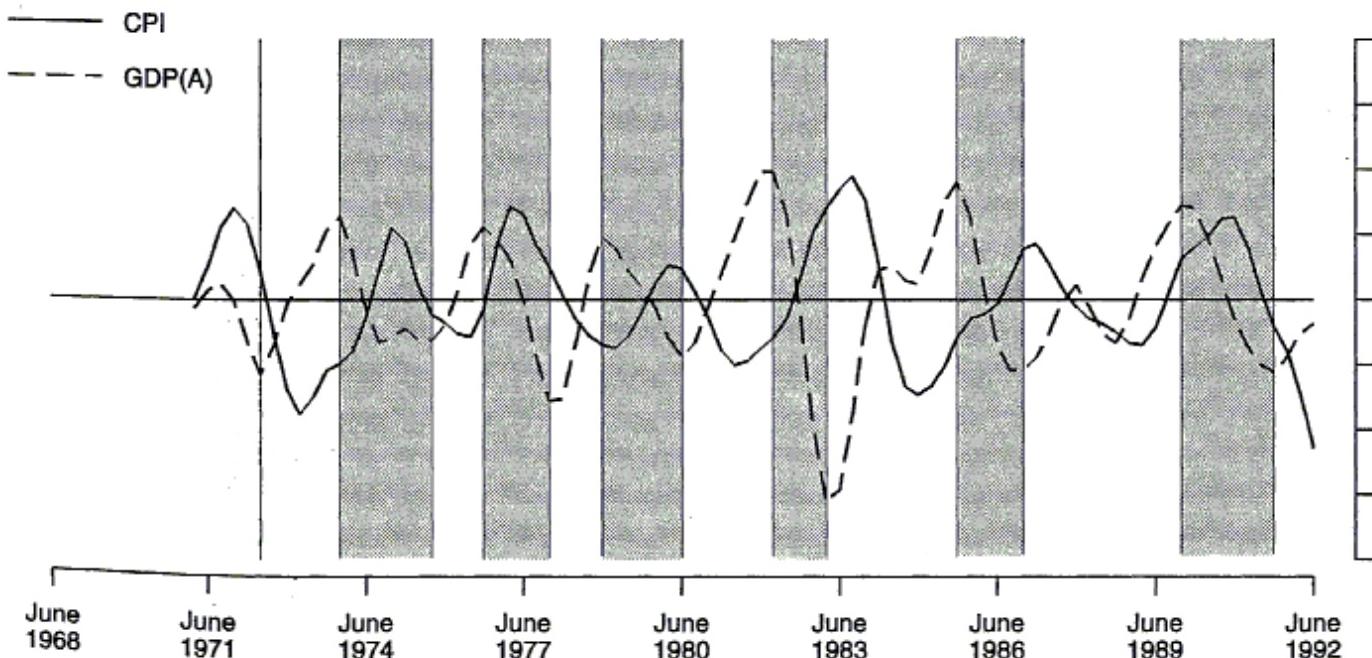


Consumer price index

The consumer price index (1989-90=100, cat. no. 6401 .0) was lagging the business cycle by five quarters on average, reflecting the pressures on production capacity. A leading counter-cyclical

relationship also appeared in the visual examination and in the cross-correlations but was rejected by Granger causality tests and by economic theory. Other aggregated prices tested, like the Producer price indexes did not demonstrate cyclical conformity with the Australian business cycle.

CHART 12. CONSUMER PRICE INDEX (1989-90 = 100) AND GDP(A), DEVIATION FROM TREND



Conclusion

The most striking general features emerging from this analysis were the following:

- None of the selected series had a “perfect” temporal relationship with the reference series. Many of the series tested showed extra or missing cycles or false signals.
- The timing at turning points was never regular.
- Most of the series led more at peaks than at troughs.
- Most of the selected indicators lead by one or two quarters or were coincident. The two techniques used to identify the lead/lag length gave consistent results.
- The cycle starting in 1977Q4 and ending in 1980Q2 was by far the most commonly missed by the indicator series selected.
- The double-turn appearing in the reference cycle in 1987Q4 was related to the October 1987 stock exchange crash and therefore appeared as an extra cycle in series related to financial markets.
- The amplitudes of cycles in the different indicators were quite different across cycles and across indicators.

The main conclusion of this article is that, while individual economic indicators contain some information about the short-term movements in aggregate economic activity, their use for forecasting the turning points in the business cycle is unreliable. This reflects the fact that all cycles are different in their causes, effects, duration and amplitude. Given these disparities, it was generally not possible to gain any information on the amplitude of the business cycle from the

individual indicators tested.

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